Airborne Emission Spectrometer

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The Airborne Emission Spectrometer (AES) is a Fourier transform spectrometer designed for remote sounding of the troposphere from an aircraft platform. The instrument covers the 650 cm-1 to 4350 cm-1 spectral range with a resolution of better than 0.1 cm-1. The primary focus of AES investigations is to study the distribution of tropospheric ozone and the factors controlling the formation and distribution of tropospheric ozone. However, having access to a wide variety of atmospheric constituents, the instrument has proven to be useful in several remote sensing applications. The instrument has been deployed on NASA's DC-8, P-3B and C-130 aircraft, collecting infrared spectra over a wide range of targets and atmospheric conditions.

The optical layout of the instrument is illustrated in Fig. 1. The spectral range of the instrument is covered with 4 channels, each optimized for a 300 cm-1 to 525 cm-1 interval. Dichroic reflectors together with a cold, remotely selectable, bandpass filter define each of the four channels. The three highest frequency channels use photovoltaic HgCdTe linear array detectors. The lowest frequency channel uses a photoconductive HgCdTe linear may. All arrays have 4 elements with each element viewing a solid angle of 1.1 mr X 8 mr. All detectors are operated at 65 K.

The Michelson interferometer employs cube corner reflectors and a Ge coated KBr beam splitter. The moving cube corner, driven with a lead screw and high torque motor, travels ± 5 cm about zero path difference every 3 s. Signals are digitized over a 2 s interval nominally centered on the zero path difference. A diode pumped Nd:YAG laser directed down the center of the interferometer optical path provides fringes used to generate the interferogram sampling clock.

The detectors view the scene through the interferometer with a 2.9 f/# system. A two axis gimbaled pointing mirror together with a gyro-stabilized pointing control system provides image motion compensation insuring a stable scene while interferograms are recorded. The instrument also includes an edge/centroid video tracking system that permits the instrument to lock onto a target in the scene if desired. The gimbaled mirror also directs a blackbody for radiometric calibration of the spectrometer.

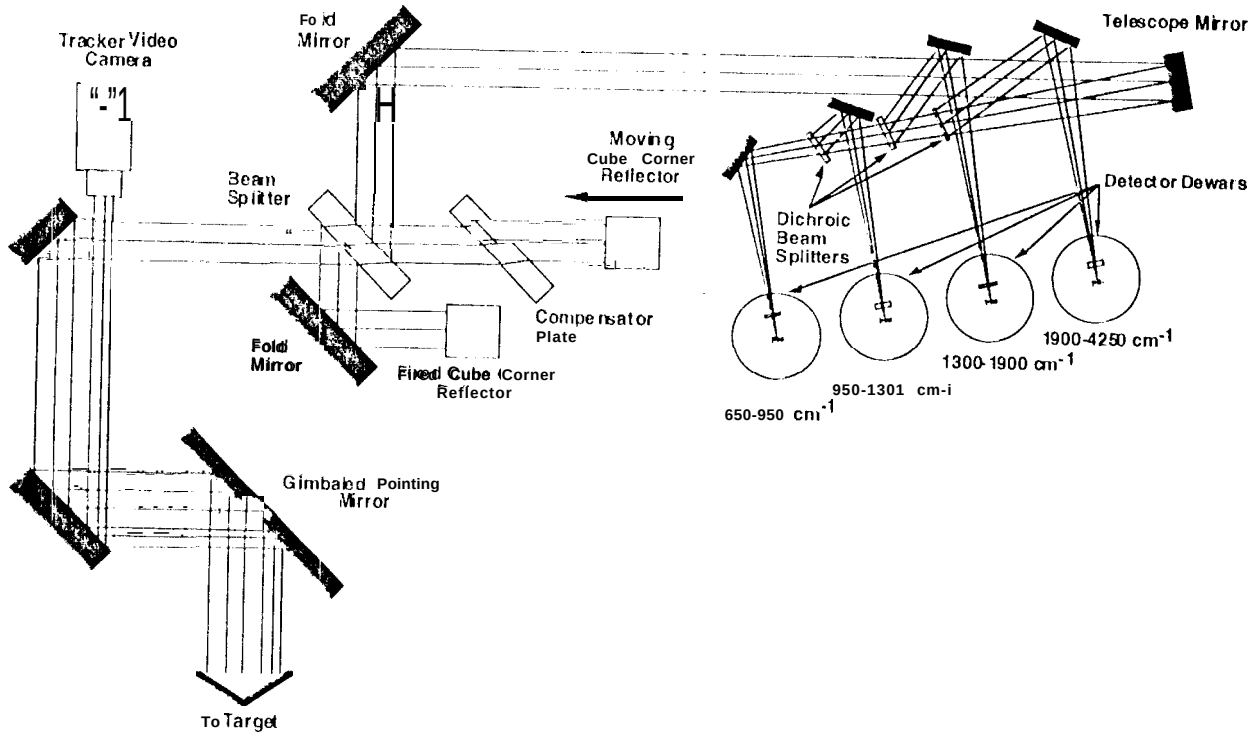

Figure 1. **Airborne** Emission Spectrometer optical layout.

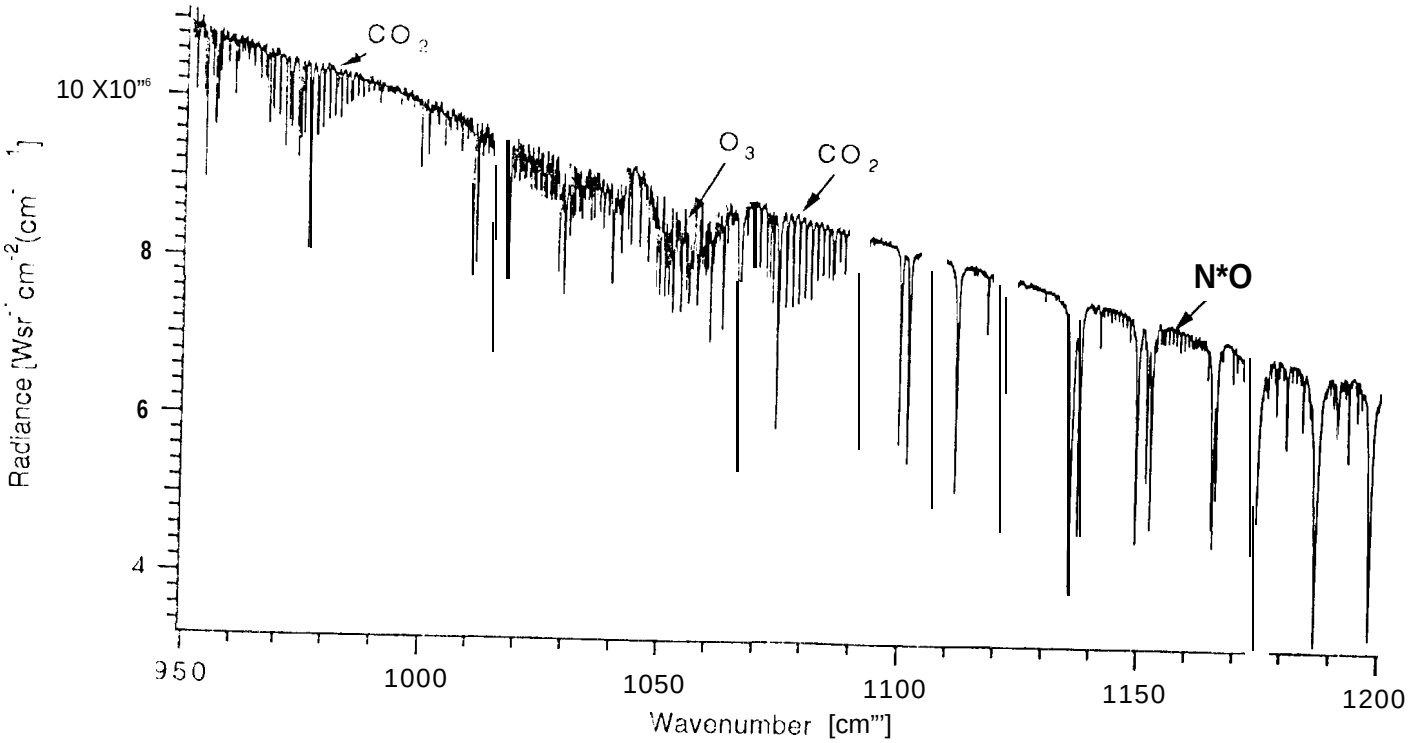

Figure 2. AES spectrum recorded **over a** forrested area from an altitude of **6 km. This spectral** region contains contributions from CO_2, O_3, N_2O and **1** H_2O.

The 16 detector signals are conditioned, bandpass filtered and digitized in an electronics module mounted on the dewars. The digitized signals are collected by a PC based instrument control system and stored on an 8 mm tape. Data processing is done off-line. The raw interferograms and engineering data are first put into a standard format to facilitate archiving. The individual interferograms are then phase corrected and transformed to spectra using standard Fourier transform techniques. Raw spectra are converted to radiances using calibration blackbody views and a linear relationship between instrument signals and radiance.

The detector dewars, interferometer and pointing mirror are mounted on a common optical bench that is isolated from the aircraft with pneumatic shock mounts. The mounts provide excellent vibration isolation at frequencies above 10 Hz.

An example of a spectrum in the 950 cm^{-1} to 1200 cm^{-1} range recorded with the instrument at an altitude of 6 km is shown in Fig 2. This region is particularly useful for measurements of tropospheric ozone and also contains spectral features of CO_2, N_2O and 1120.

The paper will describe the instrument and it's performance, and summarize recent results of field measurements.